Chapter 4

Determinants of residential satisfaction in urban China: A multi-group structural equation analysis

Abstract: Based on the 2006 wave of the China General Social Survey, this paper analyzes interregional disparities in residential satisfaction in urban China. It furthermore explores whether the determinants vary across the coastal, central and inland regions by means of a multi-group structural equation modelling (SEM). We find that residential satisfaction in the coastal region is lower than in the central and inland regions. Housing quality, housing tenure, community type, socioeconomic status and Hukou have positive impacts on residential satisfaction and the presence of children a negative effect. The magnitude of each variable's impact on residential satisfaction varies across regions. Housing quality is the most important determinant of residential satisfaction in the coastal region, community type and Hukou in the central and inland regions respectively.

Keywords: Residential satisfaction; Interregional disparities; Latent variable; Multi-group SEM; Urban China

4.1 Introduction

Over the last three decades, economic development and housing reform have brought substantial improvements to the quality of life in China, particularly to residential conditions. Before the housing reform in 1998, the so-called welfare housing supply system dominated. A typical feature of this system was that state owned companies and institutions were in charge of housing financing, construction, maintenance and allocation. Houses were allocated to urban households[13] according to the socioeconomic status of the household head (Wang and Murie, 1996; Zhao and Bourassa, 2003). As rent was extremely low, state owned institutions could not sufficiently finance construction of new houses and maintenance of existing houses (Wang and Murie, 1999; Wu, 1996). As a result, overcrowding and lack of facilities were typical for urban living conditions. To improve the situation, the national government launched a housing reform which substituted the welfare system for a market system. Private real estate enterprises were allowed to construct housing and new houses were allowed to be traded (Wang and Murie, 1999). The housing reform has substantially improved the living conditions of urban residents. For instance, per capita living space increased from 6.7 m^2 in 1978 to 32.9 m^2 in 2012.

While the reform has greatly improved average urban living conditions like living space, interregional disparities have widened because of differences in economic, social and physical environments (Demurger, 2001; Li and Fang, 2014; Yu, 2006). Urban residents in the less populated central and inland regions have, on average, larger houses than those in the economically more developed coastal region who, on the other hand, enjoy better neighborhood features and housing facilities (Yu, 2006). Meanwhile, homeownership in the coastal region is lower than in the central and inland regions (Yi and Huang, 2014). These interregional disparities may have resulted in disparities in residential satisfaction (Mohan and Twigg, 2007).

Chinese residential satisfaction studies are limited in time and space. Most of the studies are cross section analyses that focus on a population in one particular city. For instance, He and Yang (2011) analyzed residential satisfaction in Wuhan, Chen et al.

[13] Because of substantial disparities in China between rural and urban areas in housing, community and socioeconomic characteristics, this paper focuses on the urban areas and leaves the rural areas for future study. For an overview of the rural urban disparity, see amongst others Knight and Song (1999) and Park (2008).

(2013) in Dalian, Fang (2006) in a redeveloped neighborhood in Beijing and Yang et al. (2013) in Beijing. Few researchers have systematically analyzed variation in residential satisfaction across regions. Exceptions are Hu (2013) and Li and Wu (2013) who analyzed residential satisfaction among cities. However, differences among coastal, central and inland regions have not been analyzed yet.

Previous studies suffer from two methodological shortcomings. One is multicollinearity. For instance, housing size and the number of bedrooms are highly correlated which affects their standard errors and the significance levels of their estimated coefficients. Secondly, concerning cross region comparisons, different models have been estimated for different cities or for different groups of cities, as in Li and Wu (2013). Consequently, differences found may be attributable to differences in satisfaction, its determinants, the models applied, or to all of them. To reduce this kind of ambiguity, the same model needs to be applied. Multi-group analysis offers this possibility (Koufteros and Marcoulides 2006; Schumacker and Marcoulides, 1998).

This paper assesses disparities in residential satisfaction and identifies their determinants across the coastal, central and inland regions in China. Multi-group structural equation modelling (multi-group SEM) is applied to reduce the problem of multicollinearity and to estimate and test differences among the three regions on the basis of a common model. The research is based on the 2006 Chinese General Social Survey (CGSS) which provides detailed, nationwide, information on residential conditions, household and personal characteristics. [14]

The remainder of the paper is organized as follows. Section 4.2 describes the conceptual model. The multi-group SEM is discussed in section 4.3, the data and the estimated models in section 4.4. Conclusions and policy implications are presented in section 4.5.

4.2 Conceptual model

In this section, we develop the conceptual model based on a literature review and ad hoc considerations. The model, presented in Figure. 4.1, consists of the endogenous variables

[14] Although there have been several CGSS waves, the 2006 wave is the only one so far that allows analysis of residential satisfaction. Since the differences in economic and social environment among the three regions have increased rather than decreased (Fleisher et al., 2010), the relationships identified in this paper are likely to still hold.

residential satisfaction, *housing quality*, *tenure* and *community type*, and the exogenous variables *gender*, *children*, and *socioeconomic status*. Below we first discuss the endogenous variables and their relationships, next the exogenous variables and their impacts.

The main endogenous variable is *residential satisfaction*. It is a latent variable[15] defined as a household's subjective assessment of their living environment (Galster, 1987; Lu, 1999). We take *housing satisfaction* and *community satisfaction* as the two observed indicators of *residential satisfaction*. They represent related dimensions of *residential satisfaction (*Lu, 1999). Both indicators are measured on a 4-point scale, ranging from very unsatisfied to very satisfied.

Housing quality is a main determinant of *residential satisfaction* with a positive impact. It is a latent variable made up of the following indicators. The first one is *living space*. Larger per capita living space not only meets basic physical, but also psychological needs (Harris et al., 1996). Particularly, it reflects an individual's social status (Opoku and Abdul-Muhmin, 2010). Chen et al. (2013) and Fang (2006) showed that residential satisfaction increases with per capita living space in Beijing and Dalian, respectively. The *number of bedrooms*, *bathrooms* and *living rooms* are the other *housing quality* indicators. James (2008a, 2008b) shows that they play an important role in shaping residential satisfaction. Specifically, the presence of separate bedrooms for parents and children contribute to more private space. In a similar vein, bathrooms provide privacy and convenience whereas living rooms offer space for common household activities.

[15] A latent variable (or theoretical construct) denotes a variable that is supposed to exist but can be only indirectly observed, via observable indicators (Oud and Folmer, 2008). Well-known examples are welfare and socioeconomic status. Welfare is measured by indicators like per capita income, income inequality, unemployment rate, environmental quality and socioeconomic status by observables like income and education. Note the similarity between the notion of latent variable and the concept of "factor in factor analysis. For details, see Jöreskog and Sörbom (1996) and the references therein.

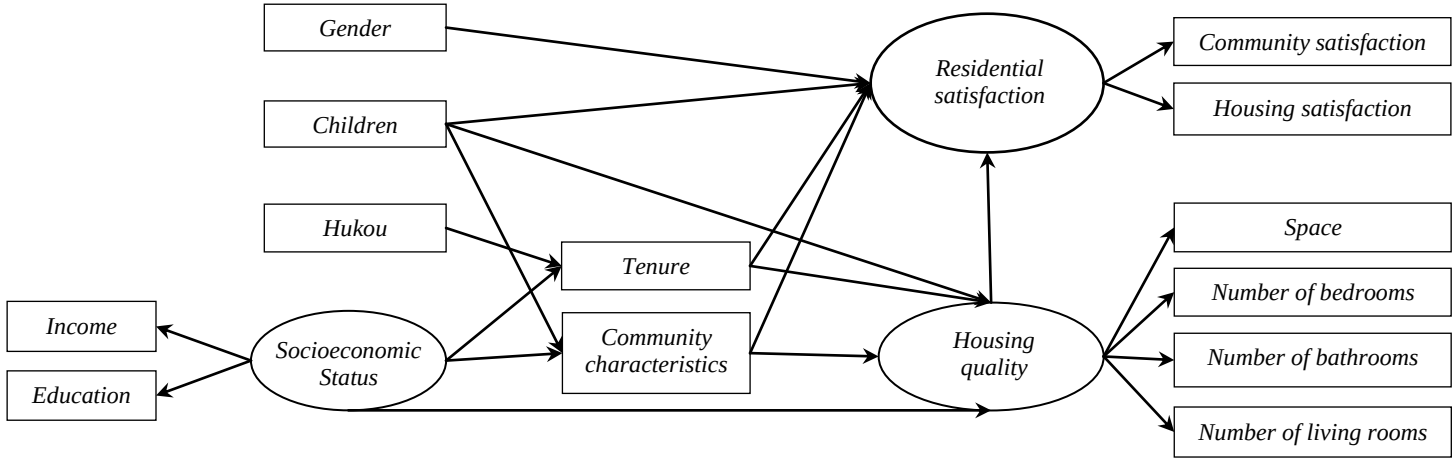

Figure. 4.1 The conceptual residential satisfaction model[16]

[16] Measurement errors, coefficients and correlations in Equations. (4.1) – (4.3) are omitted. The variables in ovals are latent variables, in boxes observables.

The next explanatory variable of *residential satisfaction* is *tenure.* Homeowners tend to be more satisfied with their housing and community characteristics than tenants (Deurloo et al., 1994; Diaz-Serrano, 2009; Elsinga and Hoekstra, 2005; Parkes et al., 2002) because they generally have less incentives to move out of their current community (Dietz and Haurin, 2003; Helderman et al., 2004; Rohe and Stewart, 1996). They therefore are more likely to participate in community activities and management, and construct social bonds with their neighbors (Deurloo et al., 1994; DiPasquale and Glaeser, 1999). In addition, home owners are at less risk than renters of being involuntarily moved from their homes. Chen et al. (2013) finds that the impact of homeownership on residential satisfaction is significant and positive in the Chinese city of Dalian. Thus, we hypothesize that *tenure* has a positive impact on *residential satisfaction*.

The final endogenous explanatory variable of *residential satisfaction* is *community type.* Residents highly appreciate communities with good leisure facilities, local shops, public facilities like public transportation, schools and health care, environmental quality, and safety (Dekker et al., 2011; Hipp, 2010; Lu, 1999; Nathan, 1995; Nunkoo Ramkissoon, 2011). The data set does not contain information on the above community facilities. However, for each respondent there is information on the type of community they live in which globally corresponds to the presence of the above characteristics. Therefore, we take community type as a proxy. Communities are classified into four groups: (i) shanty community; (ii) affordable, old and resettled housing community; (iii) commodity housing community (constructed by private real estate development companies) and state-constructed community; (iv) upscale community. A shanty community is crowded, has poor public transportation and insufficient sanitary and leisure facilities. An affordable, old and resettled housing community is better than a shanty community in terms of sanitary facilities, but still lacks public transportation and leisure facilities. A commodity housing community and state-constructed community has good public transportation and sanitary and leisure facilities. An upscale community has high-quality green space, besides good sanitary and leisure facilities.

We take *housing quality* as an endogenous variable that is positively affected by the endogenous variables *tenure* and *community type*. The rationale for the former relationship is that home owners take more actions to improve the quality of their housing to suit their needs (Davidson and Leather, 2000; Dekker et al, 2011). Henderson (1985) show that *community type* positively impacts on *housing quality*. The implications of

these hypothesized relationships are that *tenure* and *community type*, in addition to their direct impacts on *residential satisfaction*, have indirect impacts, via *housing quality*. *Housing quality*, like *tenure* and *community type*, is furthermore a function of exogenous variables (see below).

We next turn to the exogenous variables. We consider *gender* as determinant of *housing satisfaction*. The rationale is that women generally spend more time in their communities than men and thus have more friends and acquaintances in their neighborhoods (Reid and Comas-Diaz, 1990). Women also spend more time at home than men and thus adapt their homes more to suit their needs. Hence, we hypothesize that women tend to be more satisfied with their houses and communities than men. Several studies support the hypothesis, e. g Lu (1999), Ibem and Aduwo (2013) and Ibem and Amole (2012).

Although there is no consensus about its impact in the literature, we consider *children* as a determinant of *residential satisfaction*. Brodsky et al. (1999) and Dekker et al. (2011) found that parents with children are less satisfied with their residential conditions than those without children because of additional demands such as playgrounds, safe and healthy environment, and extra rooms. However, Guest and Wierzbicki (1999) and Parkes et al. (2002) argue that children are an important intermediary in generating social bonding which in turn results in higher residential satisfaction.

We also hypothesize that *children* have an impact on *housing quality* and *community type* since most families only have one child in urban China. Therefore, they pay much attention to their children's wellbeing inter alia by providing decent living and community conditions for them. Thus, parents with children are generally more critical about the size of their house, facilities in the house and the atmosphere of their community (Brodsky et al., 1999). Therefore, ceteris paribus, we expect households with children to be less satisfied with their houses and communities than those without.

We take *socioeconomic status* as a latent variable made up of the highly correlated indicators *income* and *education*. We assume *socioeconomic status* to indirectly impact on *residential satisfaction*, via *housing quality*, *community type* and *tenure*. After the establishment of the market-based housing supply system, urban residents were allowed to purchase houses at the market (Wang and Murie, 1996, 1999) which rendered income

an important determinant of tenure (Huang, 2003; Li and Chen, 2011; Logan et al., 2010). Moreover, households with higher income could more easily relocate from one community to another to meet their demand for community characteristics (Teck-Hong, 2012). In addition, high-income households have more financial means than poor households to furniture and decorate their houses with positive impacts on *housing quality*. Finally, residents with higher education are better conditioned for housing and community search than their less educated peers (Fredrickson et al., 1980). On the basis of the above considerations, we expect *socioeconomic status* to have positive impacts on *housing quality*, *community type* and t*enure*.

The final exogenous variable is *Hukou* which, like *socioeconomic status*, is assumed to indirectly impact on *residential satisfaction* via *tenure*. Without a permanent *Hukou*, individuals are excluded from the urban welfare system and have no access to public housing or government-subsidized housing (Wu, 2002, 2004). What's more, individuals without a permanent *Hukou* are poorer than local urban residents and their income is unstable which hinder them obtaining a bank mortgage for commercial housing. As housing prices have dramatically increased, most of migrants cannot afford to purchase a decent house. Thus, individuals without a permanent *Hukou* are less likely to be a home owner.

4.3 Multi-group SEM

We apply a multi-group SEM to simultaneously estimate the same satisfaction model (presented in Figure. 4.1) for each group and to test the equality of parameters across groups (Deng et al., 2005). As a SEM, a multi-group SEM can handle latent and observed variables and their relationships within an integrated framework (Jöreskog and Sörbom, 1996). A multi-group SEM is a system of equations model composed of two measurement models and a structural model.

The measurement models present the relationship between the latent variables and their indicators. Measurement model (4.1) relates to the endogenous variables and model (4.2) to the exogenous variables:[17]

[17] It is possible to include intercepts in the measurement models and the structural model. However, the empirical analysis is in terms of standardized variables and beta coefficients. Therefore, intercepts are not included here.

$$\boldsymbol{y}^g = \boldsymbol{\Lambda}_{\boldsymbol{y}}^g \boldsymbol{\eta}^g + \boldsymbol{\varepsilon}^g \quad \text{with } cov(\boldsymbol{\varepsilon}^g) = \boldsymbol{\Theta}_{\boldsymbol{\varepsilon}}^g, \tag{4.1}$$

$$\boldsymbol{x}^g = \boldsymbol{\Lambda}_{\boldsymbol{x}}^g \boldsymbol{\xi}^g + \boldsymbol{\delta}^g \quad \text{with } cov(\boldsymbol{\delta}^g) = \boldsymbol{\Theta}_{\boldsymbol{\delta}}^g, \tag{4.2}$$

where $\boldsymbol{y}$ denotes a $p \times 1$ vector of endogenous observed variables, $\boldsymbol{x}$ a $q \times 1$ vector of exogenous observed variables, $\boldsymbol{\eta}$ an $m \times 1$ vector of latent endogenous variables, and $\boldsymbol{\xi}$ an $n \times 1$ vector of latent exogenous variables. $\boldsymbol{\Lambda_y}$ and $\boldsymbol{\Lambda_x}$ are $p \times m$ and $q \times n$ matrices of coefficients (loadings), respectively. $\boldsymbol{\varepsilon}$ and $\boldsymbol{\delta}$ stand for $p \times 1$ and $q \times 1$ vectors of measurement errors of $\boldsymbol{y}$ and $\boldsymbol{x}$, respectively. $\boldsymbol{\Theta_\varepsilon}$ ($p \times p$) and $\boldsymbol{\Theta_\delta}$ ($q \times q$) are the covariance matrices of $\boldsymbol{\varepsilon}$ and $\boldsymbol{\delta}$, respectively. The superscript g refers to the gth group, g=1,…,G.

The structural model presents the relationships between the latent exogenous and latent endogenous variables as well as the relationships among the latent endogenous variables mutually. It reads:

$$\boldsymbol{\eta}^g = \boldsymbol{B}^g \boldsymbol{\eta}^g + \boldsymbol{\Gamma}^g \boldsymbol{\xi}^g + \boldsymbol{\zeta}^g \quad \text{with } cov(\boldsymbol{\xi}^g) = \boldsymbol{\Phi}^g,\ cov(\boldsymbol{\zeta}^g) = \boldsymbol{\Psi}^g, \tag{4.3}$$

where $\boldsymbol{B}$ is an $m \times m$ matrix of structural relationships among the latent endogenous variables mutually, $\boldsymbol{\Gamma}$ an $m \times n$ matrix of the coefficients of the impacts of the exogenous latent variables on the endogenous latent variables and $\boldsymbol{\zeta}$ a random $m \times 1$ vector of errors. $\boldsymbol{\Phi}$ ($n \times n$) and $\boldsymbol{\Psi}$($m \times m$) are the covariance matrices of $\boldsymbol{\xi}$ and $\boldsymbol{\zeta}$, respectively.

The conceptual model in Figure. 4.1 in terms of Equations (4.1) - (4.3) reads as follows:[18]

$$\begin{bmatrix} \textit{Housing satisfaction} \\ \textit{Community satisfaction} \\ \textit{Space} \\ \textit{Number of bedrooms} \\ \textit{Number of bathrooms} \\ \textit{Number of living rooms} \\ \textit{Tenure} \\ \textit{Community type} \end{bmatrix}^g = \begin{bmatrix} \lambda_{1,1} & 0 & 0 & 0 \\ \lambda_{2,1} & 0 & 0 & 0 \\ 0 & \lambda_{3,2} & 0 & 0 \\ 0 & \lambda_{4,2} & 0 & 0 \\ 0 & \lambda_{5,2} & 0 & 0 \\ 0 & \lambda_{6,2} & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}^g \times \begin{bmatrix} \textit{Residential satisfaction} \\ \textit{Housing quality} \\ \textit{Tenure} \\ \textit{Community type} \end{bmatrix}^g + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \varepsilon_4 \\ \varepsilon_5 \\ \varepsilon_6 \\ 0 \\ 0 \end{bmatrix}^g \tag{4.4}$$

$$\begin{bmatrix} \textit{Gender} \\ \textit{Children} \\ \textit{Income} \\ \textit{Education} \\ \textit{Hukou} \end{bmatrix}^g = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & \lambda_{3,3} & 0 \\ 0 & 0 & \lambda_{4,3} & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}^g \times \begin{bmatrix} \textit{Gender} \\ \textit{Children} \\ \textit{Socioeconomic status} \\ \textit{Hukou} \end{bmatrix}^g + \begin{bmatrix} 0 \\ 0 \\ \delta_3 \\ \delta_4 \\ 0 \end{bmatrix}^g \tag{4.5}$$

[18] *Tenure*, *gender*, *children*, *community characteristics* and *Hukou* are single-indicator latent variables with loadings equal to 1 (before estimation) and measurement errors fixed at 0.

$$\begin{bmatrix} Residential\ satisfaction \\ Housing\ quality \\ Tenure \\ Community\ type \end{bmatrix}^g = \begin{bmatrix} 0 & \beta_{1,2} & \beta_{1,3} & \beta_{1,4} \\ 0 & 0 & \beta_{2,3} & \beta_{2,4} \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}^g \times \begin{bmatrix} Residential\ satisfaction \\ Housing\ quality \\ Tenure \\ Community\ type \end{bmatrix}^g$$

$$+ \begin{bmatrix} \gamma_{1,1} & \gamma_{1,2} & 0 & 0 \\ 0 & \gamma_{2,2} & \gamma_{2,3} & 0 \\ 0 & 0 & \gamma_{3,3} & \gamma_{3,4} \\ 0 & \gamma_{4,2} & \gamma_{4,3} & 0 \end{bmatrix}^g \times \begin{bmatrix} Gender \\ Children \\ Socioeconomic\ status \\ Hukou \end{bmatrix}^g + \begin{bmatrix} \zeta_1 \\ \zeta_2 \\ \zeta_3 \\ \zeta_4 \end{bmatrix}^g \tag{4.6}$$

Note that for each latent variable the variance is fixed (at 1) to assign it a measurement scale and render the model identified (see Jöreskog and Sörbom (1996) for details).

The indicators of *housing satisfaction*, and the variables *community satisfaction*, *tenure*, *gender*, *children and Hukou*, are ordinal or dichotomous. Therefore, we shall apply the Weighted Least Squares (WLS) estimator based on the matrix of polychoric correlations (see Flora and Curran (2004); Jöreskog and Sörbom (1996) for details). The ISREL 8.8 software package will be applied to estimate the model (Jöreskog and Sörbom,1996).

A variety of statistics to evaluate the goodness-of-fit of a (multi-group) SEM are available in LISREL 8.8 including the χ^2 statistic and the root mean square error of approximation (RMSEA), the goodness-of-fit index (GFI), the adjusted goodness-of-fit index (AGFI) and the comparative fit index (CFI). The χ^2 is inappropriate to assess the goodness-of-fit of the SEM in this study, as the number of observation for each group is larger than 1,000 and because of the presence of ordinal and dichotomous observed variables (Bollen, 1989; Jöreskog and Sörbom, 1996). Therefore, the model fit will be evaluated by means of the RMSEA, GFI, AGFI and CFI.

The χ^2 can be used to test nested constraints, particularly, whether or not the estimated model holds for all three regions. In that case the test statistic is:

$$\Delta\chi^2 = \chi_0^2 - \chi_1^2, \tag{4.7}$$

where χ_0^2 and χ_1^2 are the overall model fit χ^2 values under the null and the alternative hypothesis, respectively, and df_0 and df_1 the corresponding degrees of freedom. The null is rejected at significant level α if $P\left(\chi^2_{df_0-df_1} \geq \Delta\chi^2\right) < \alpha$, with $\chi^2_{df_0-df_1}$ the critical chi-square value with $df_0 - df_1$ degrees of freedom.

4.4 Data and empirical results

4.4.1 Data

The dataset analyzed comes from the national Chinese General Social Survey (CGSS) which was conducted in 2003, 2004, 2005, 2006, 2008 and 2010 (Bian and Li, 2012). The CGSS contains detailed information on personal characteristics, household and housing conditions. However, information on residential satisfaction was only collected in the 2006. In the 2006 wave, 6,013 urban residents in 28 provinces in mainland China were interviewed. [19] 880 observations (14.63%) are excluded because of incomplete information which gives a total of 5,133 observations for empirical analysis.

To account for disparities in residential conditions, and local physical and socioeconomic conditions across the coastal, central and inland regions, we divided the 5,133 observations into three groups according to region: 2,383 observations (46.43%) in the coastal region, 1,519 (29.59%) in the central region, and 1,231 (23.98%) in the inland region[20]. Appendix 4.A presents the provinces belonging to each region.

Descriptive statistics on housing and community satisfaction, housing characteristics and household characteristics are presented in Table 4.1. The table shows that residents in the coastal region have higher education and income than their counterparts in the central and inland regions but enjoy smaller housing. In addition, home ownership is lower in the coastal region which is consistent with Yi and Huang (2014). It is probably due to substantially higher housing prices and lower housing affordability in the coastal region.

[19] There are 31 provinces, major metropolitan municipalities, and autonomous regions in mainland China. Qinghai, Ningxia and Tibet were not covered in the 2006. As the populations in these three provinces only account for a very small proportion of the national population, their absence will not seriously affect the national representativeness of the survey (Bian and Li, 2012).

[20] This distribution is in line with the regional distribution of China's urban population in 2006: 48.36%, 29.26% and 22.38% in the coastal, central, and inland regions, respectively (China Statistics Yearbook, 2007).

Table 4.1 Descriptive statistics for the observed variables

Variable	Coastal region				Central Region				Inland region			
	Mean	S. D.	Min.	Max.	Mean	S. D.	Min.	Max.	Mean	S. D.	Min.	Max.
Housing satisfaction [a]	2.47	0.75	1	4	2.57	0.77	1	4	2.54	0.79	1	4
Community satisfaction [a]	2.61	0.63	1	4	2.68	0.64	1	4	2.66	0.66	1	4
Space (m^2)	27.91	20.18	4	250	30.47	22.37	4	255	28.75	17.74	4	160
Number of bedrooms	2.10	1.05	1	9	2.26	1.16	1	9	2.32	1.12	1	9
Number of bathrooms	0.90	0.44	0	4	0.79	0.53	0	4	0.93	0.42	0	5
Number of living rooms	0.87	0.55	0	4	0.94	0.62	0	3	1.04	0.47	0	3
Community type [b]	2.47	0.52	1	4	2.30	0.50	1	4	2.39	0.49	2	4
Tenure (0=rent, 1=own)	0.70	0.46	0	1	0.85	0.36	0	1	0.72	0.45	0	1
Gender (0=male, 1=female)	0.55	0.50	0	1	0.55	0.50	0	1	0.54	0.50	0	1
Children [c]	0.36	0.48	0	1	0.47	0.50	0	1	0.52	0.50	0	1
Income (1,000yuan/year)	44.28	229.23	2	8,000	21.22	25.40	2	500	23.30	73.34	1	2,500
Education [d]	4.07	1.57	1	8	3.55	1.39	1	7	3.65	1.53	1	8
Hukou [e]	0.84	0.37	0	1	0.86	0.34	0	1	0.80	0.40	0	1

Notes:

a. 1=very unsatisfied; 2=unsatisfied; 3=satisfied; 4=very satisfied.

b. 1=shanty community; 2=affordable, old and resettled housing community; 3=commodity housing and state-constructed community; 4=upscale community.

c. 0=no children under 16 years old in the family; 1=at least one child under 16 years old in the family.

d. 1=Illiterate; 2=primary school; 3=junior high school; 4=senior high school; 5=polytechnic school; 6=junior college; 7=bachelor; 8=master or above.

e. 1=with a permanent Hukou in the city; 0= without a permanent Hukou in the city.

The table shows furthermore that housing satisfaction and community satisfaction in the coastal region are lower than in the central and inland regions. Nonparametric Kruskal-Wallis One-way ANOVA leads to the rejection of the hypotheses that there are no differences among the three regions in housing satisfaction and community satisfaction: χ^2=14.20, *df*=2, p-value=0.00, and χ^2=9.43, *df*=2, p-value=0.01, respectively.[21]

4.4.2 Empirical results

We first test invariance of the *residential satisfaction* model across the three regions by applying multi-group SEM. The basic invariance null hypothesis reads:

H1 *The same model holds for all three regions.*

If H1 is rejected, we shall test if the same model holds for 2 regions (H2: for the coastal and central regions; H3: for the coastal and inland regions; H4: for the central and inland regions). If all four invariance hypotheses are rejected, we shall estimate region-specific models.

The results of the χ^2 difference tests are presented in Table 4.2. The table shows that that all four hypotheses are rejected at 0.01 level, which implies that the impacts of the determinants on residential satisfaction vary among the three regions. Interpretations are given in the next subsection.

Table 4.2 Invariance tests of residential satisfaction SEMs across regions

No.	Hypothesis	χ^2	*df*	$\Delta\chi^2$	Δdf	Sign. Level	Decision
H1	Null hypothesis: *The same model holds for all three regions.*	1869.25	155	312.81	26	0.00	Rejected
	Alternative hypothesis	1556.44	129				
H2	Null hypothesis: *The same model holds for the coastal and central regions.*	1255.08	99	112.22	13	0.00	Rejected
	Alternative hypothesis	1142.86	86				
H3	Null hypothesis: *The same model holds for the coastal and inland regions.*	1155.47	99	161.52	13	0.00	Rejected
	Alternative hypothesis	993.95	86				
H4	Null hypothesis: *The same model holds for the central and inland regions.*	975.62	99	126.78	13	0.00	Rejected
	Alternative hypothesis	848.84	86				

[21] As *housing satisfaction* and *community satisfaction* are ordinal variables, we applied the nonparametric Kruskal-Wallis test.

The region specific SEMs

Before going into detail, we observe that the estimated coefficients are standardized or beta coefficients.[22] A consequence is that the scales of the explanatory variables are irrelevant and the estimated coefficients are directly comparable.

The overall goodness of fit indices of the SEM models of the three regions are reported in Table 4.3. The table shows that for each region the overall goodness of fit indices meet their critical values indicating that the empirical models have good overall fit.[23]

Table 4.3 Overall goodness of fit statistics

Fit index	Coastal region	Central region	Inland region	Critical value
Goodness-of-fit index (GFI)	0.99	0.99	0.99	>0.95
Adjusted goodness-of-fit index (AGFI)	0.97	0.97	0.97	>0.95
Root mean square error of approximation (RMSEA)	0.07	0.07	0.07	<0.08
Comparative fit index (CFI)	1.00	1.00	1.00	>0.95

The measurement equations of the endogenous and exogenous latent variables consisting of factor loadings, standard errors and R^2 s are presented in Table 4.4. For all three regions, the loadings are significant at 0.01 significance level and exceed the recommended minimum magnitude of 0.20 (Jöreskog and Sörbom, 1996). The table furthermore shows that while the loadings of *housing satisfaction*, *space*, *number of bedrooms* and *education* only vary slightly across the three models, the loading of *income* varies from 0.27 in the coastal region to 0.82 in the central region. The reliabilities or R^2 s (i.e. the proportion of the variance of an indicator explained by its latent variable) of the indicators *housing satisfaction*, *space* and *number of bedrooms* are quite stable across the models. For *community satisfaction*, *number of bathrooms* and *number of living rooms*, there is quite some variation. The indicators *income* and *education* have relatively low reliabilities (*Income* in the central region is an exception.). We therefore substituted the latent variable *socioeconomic status* for its directly observed indicators. The substitution

[22] A standardized coefficient represents the standard deviation change in the dependent variable caused by a standard deviation change in an independent variable. For instance, from the coastal region model (Table 4.4) it follows that a standard deviation increase in *residential satisfaction* leads to a 0.91 standard deviation increase in *housing satisfaction* and a 0.73 standard deviation increase in c*ommunity satisfaction.*

[23] For more information about the critical value see amongst others Hooper et al. (2008).

only marginally changed the structural model and the other equations of measurement models. Therefore, we retained the model with *socioeconomic status*.[24]

The main results in Table 4.4 are the estimated loadings of *housing satisfaction* and *community satisfaction*. The estimated loadings of the former are uniformly larger than those of the latter indicating that *residential satisfaction* manifests itself more strongly via *housing quality* than via *community type*. The R^2 s of *housing satisfaction* are also uniformly larger. The rankings of the loadings and R^2 s of the other indicators vary across the regional models in an unsystematic manner. Nevertheless, the results show that s*pace* and *number of bathrooms* are the indicators of *housing quality* with the highest loadings and reliabilities in all three models while *income* is the indicator of *socioeconomic status* with the largest loading and highest reliability, except in the inland region model where *education* has the highest reliability.

Table 4.4 Standardized coefficients of the measurement models

Latent variable	Indicator	Coastal region			Central region			Inland region		
		Coefficient	S.E.	R^2	Coefficient	S.E.	R^2	Coefficient	S.E.	R^2
Residential satisfaction	*Housing satisfaction*	0.91***	0.03	0.83	0.96***	0.04	0.93	0.97***	0.06	0.95
	Community satisfaction	0.73***	0.02	0.53	0.61***	0.02	0.37	0.54***	0.03	0.30
Housing quality	*Space*	0.98***	0.06	0.87	0.94***	0.08	0.89	0.97***	0.07	0.94
	Number of bedrooms	0.50***	0.03	0.25	0.44***	0.03	0.20	0.49***	0.04	0.24
	Number of bathrooms	0.60***	0.03	0.36	0.96***	0.04	0.93	0.60***	0.04	0.36
	Number of living rooms	0.63***	0.03	0.40	0.87***	0.04	0.75	0.44***	0.03	0.19
Socioeconomic status	*Income*	0.27***	0.04	0.07	0.82***	0.02	0.68	0.37***	0.03	0.08
	Education	0.21***	0.03	0.04	0.26***	0.03	0.07	0.28***	0.04	0.13

Note: ***<0.01

We now turn to the structural models presented in Table 4.5, the residential satisfaction equation in particular. The first feature to note is that the R^2s indicate that 16%, 21% and 13% of the variation in *residential satisfaction* is explained by the explanatory variables in the three structural models. This outcome is higher than in Chen (2013) and Hu (2013), which indicates that the SEM applied here has more explanatory power. A second feature is that the magnitude and significance of each variable's impact on *residential satisfaction* vary across regions. Below, we discuss the impact of each variable.

[24] The model with *education* and *income* substituted for the latent variable *socioeconomic status* is available from the first author upon request.

Table 4.5 Standardized coefficients of the structural models

Explanatory variables	Coastal region				Central region				Inland region			
	Residential satisfaction	Housing quality	Tenure	Community	Residential satisfaction	Housing quality	Tenure	Community	Residential satisfaction	Housing quality	Tenure	Community
Housing quality	0.44***				0.08***				0.12***			
	(0.06)				(0.04)				(0.04)			
Tenure	0.32***	0.15***			0.27***	0.11***			0.34***	0.11***		
	(0.04)	(0.02)			(0.04)	(0.02)			(0.06)	(0.03)		
Community type	0.16***	0.34***			0.25***	0.48***			0.27***	0.41***		
	(0.04)	(0.06)			(0.05)	(0.06)			(0.06)	(0.14)		
Gender	-0.04				0.03				0.06**			
	(0.04)				(0.04)				(0.03)			
Children	-0.10**	-0.29***		0.01	-0.16***	-0.28***		0.04	-0.04	-0.50***		0.08
	(0.05)	(0.03)		(0.03)	(0.04)	(0.04)		(0.04)	(0.06)	(0.11)		(0.04)
Socioeconomic status		0.16***	0.58***	0.25***		0.15***	0.48***	0.23***		0.30***	1.56**	0.10***
		(0.03)	(0.22)	(0.04)		(0.03)	(0.23)	(0.04)		(0.07)	(0.80)	(0.03)
Hukou			0.83***				0.72***				1.99***	
			(0.23)				0.24				(0.85)	
R^2	0.16	0.19	0.40	0.06	0.21	0.38	0.34	0.06	0.13	0.40	0.70	0.03

Notes: Standard errors in parenthesis. **p<0.05, ***p<0.01.

Consistent with existing literature (among others Dekker et al., 2011), *housing quality* positively and significantly impacts *residential satisfaction* in all three models, indicating that more living space, bedrooms, bathrooms and living rooms result in higher residential satisfaction. The impact in the coastal region is much larger than in the central and inland regions. A possible explanation is that on average housing quality in the coastal region is less than in the other two regions (see Table 4.1) and is thus more appreciated.

Tenure also has a positive and significant impact on the *residential satisfaction* in all three models which confirms the hypothesis in the conceptual model that homeowners are more satisfied than renters. The results also show that the impact in the coastal and inland region models is larger than in the central region model. This may be due to the fact that home ownership rate in the former regions is smaller than in the central region (see Table 1), and thus more people are at the risk of being involuntarily moved from their living place.

Community type has a significant and positive impact in all three models, as hypothesized. The impact in the coastal and central region models is slightly smaller than in the inland region model. A possible explanation is that compared to the inland region, more public goods (such as public transportation, schools, hospitals) are provided to improve the shanty, old and resettled housing community in the coastal and central regions (Zhang and Kanbur, 2005), which reduces the difference among communities.

In the inland region model, the coefficient of *gender* has the expected sign and is significant which confirms the hypothesis in the conceptual model. However, the difference between women and men is insignificant in the coastal and central regions. For the coastal and central regions, this is probably related to the fact that female labor market participation is high and the time females spend in their residential community is not significantly more than that of males.

The presence of *children* in the household has a negative and significant impact on *residential satisfaction* in the coastal and central region models which is in line with Brodsky et al. (1999) and Dekker et al. (2011), whereas it has an insignificant impact in the inland region. A possible explanation is that parents with young children are less critical about their living place in the inland region, due to the fact that female labor market participation in the inland region is lower than in the coastal and central regions

and mothers in the inland region thus spend more time caring for their children (Yao and Xu, 2013).

Finally note that *community type*, *tenure* and *socioeconomic status* have significant and positive impacts on *housing quality* in all three models while the presence of *children* has a negative, significant impact. In all three models, the main determinants of *tenure* are *socioeconomic status* and *Hukou* with significant, positive effects while the only significant determinant of *community type* is *socioeconomic status*.[25]

Table 4.6 presents the standardized indirect and total impacts[26] of the explanatory variables on *residential satisfaction* and on its indicators *housing satisfaction* and *community satisfaction*.[27] Below we only discuss the total effects.

In descending order of magnitude, *housing quality*, *tenure*, *socioeconomic status*, *Hukou* and *community type* have the largest positive, significant total impacts on *residential satisfaction* in the coastal region model. Furthermore, the presence of *children* has a negative, significant impact and *gender* an insignificant effect. Similar observations apply to the indicators *housing satisfaction* and *community satisfaction* with the latter somewhat smaller (*children*) impacts than the former which is due to its smaller loading. In the central region model, *community type* has the largest impact on *residential satisfaction*, followed by *tenure*, *socioeconomic status*, *Hukou* and *housing quality*. Again, the presence of *children* has a negative total impact and *gender* an insignificant. The same order holds for the indicators. In the inland region model, *Hukou* has the largest impact on *residential satisfaction*, followed by *socioeconomic status*, *tenure*, *community type* and *housing quality*. Furthermore *gender* has a significant, positive impact and *children* a negative, though insignificant impact.

[25] We focus on the determinants of *residential satisfaction* which is the core of the paper. Therefore we do not provide further explanations for the *housing quality*, *tenure* and *community type* models.

[26] The total impact of an (endogenous or exogenous) explanatory variable on an endogenous variable is the sum of its direct and indirect impacts. An indirect impact materializes via an intermediary endogenous variable. Direct effects are given by the measurement and structural models (the coefficients in Tables 4 and 5).

[27] Since they impact on the indicators *housing satisfaction* and *community satisfaction* via the latent variable *residential satisfaction*, there are no direct effects of the explanatory on these indicators. Hence, their indirect effects are their total effects.

Table 4.6 Standardized indirect and total impacts

Explanatory variables	Coastal region				Central region				Inland region			
	Indirect impacts	Total impacts			Indirect impacts	Total impacts			Indirect impacts	Total impacts		
	Residential satisfaction	Residential satisfaction	Housing satisfaction	Community satisfaction	Residential satisfaction	Residential satisfaction	Housing satisfaction	Community satisfaction	Residential satisfaction	Residential satisfaction	Housing satisfaction	Community satisfaction
Housing quality		0.44***	0.40***	0.32***		0.08**	0.07**	0.05**		0.12***	0.12***	0.07***
		(0.06)	0.03	0.03		(0.04)	0.03	0.02		(0.04)	0.04	0.02
Tenure	0.07***	0.39***	0.35***	0.28***	0.01	0.28***	0.27***	0.17***	0.01	0.36***	0.35***	0.19***
	(0.01)	(0.04)	0.03	0.02	(0.01)	(0.04)	0.03	0.02	(0.01)	(0.06)	0.05	0.03
Community type	0.15***	0.31***	0.28***	0.23***	0.04**	0.29***	0.28***	0.18***	0.05***	0.32***	0.31***	0.15***
	(0.04)	(0.04)	0.02	0.02	(0.02)	(0.04)	0.03	0.02	(0.02)	(0.05)	0.04	0.03
Gender		-0.04	-0.03	-0.03		0.03	0.03	0.02		0.06**	0.06**	0.03
		(0.04)	0.02	0.02		(0.04)	0.03	0.02		(0.03)	0.04	0.02
Children	-0.11***	-0.20***	-0.18***	-0.14***	-0.01	-0.17***	-0.16***	-0.10***	-0.04***	-0.08	-0.07	-0.04
	(0. 03)	(0.04)	0.03	0.02	(0.02)	(0.04)	0.03	0.02	(0.04)	(0.05)	0.04	0.02
Socioeconomic status	0.37***	0.37***	0.34***	0.27***	0.21***	0.21***	0.21***	0.13***	0.38***	0.38***	0.37***	0.21***
	(0.07)	(0.07)	0.04	0.04	(0.05)	(0.05)	0.04	0.03	(0.11)	(0.11)	0.08	0.05
Hukou	0.32***	0.32***	0.29***	0.23***	0.20***	0.20***	0.20***	0.12***	0.39***	0.39***	0.38***	0.21***
	(0.08)	(0.08)	0.05	0.04	(0.06)	(0.06)	0.05	0.03	(0.11)	(0.11)	0.09	0.05

Note:
Standard errors in parenthesis.
**p<0.05, ***p<0.01.
Since there are no endogenous variables that impact on *tenure* and *community type*, there are no indirect impacts on *tenure* and *community type*. Hence, the standardized total impacts for these two variables equal the standardized coefficients given in Table 4.5.
Since they impact on the indicators *housing satisfaction* and *community satisfaction* via the latent variable *residential satisfaction*, there are no direct effects of the explanatory on these indicators. Hence, their indirect effects are their total effects.

The magnitude of each variable's total impact on *residential satisfaction* and its indicators vary across models. It is nevertheless clear that *tenure* and *community type* are major determinants with substantial positive direct impacts and smaller indirect effects in all three regional specific models. *Socioeconomic status* and *Hukou* also have substantial positive effects, though indirectly via *tenure*. The total impact of *housing quality* varies from 0.44 in the coastal region model to 0.08 in the central region model (on *residential satisfaction*). This is due to the fact that on average housing quality in the coastal region is less than in the other two regions (see Table 4.1) and is thus more appreciated. Meanwhile, the total *gender* impact is only significant in the inland region model due to the fact that female labor market participation rate is low. Consequently, the time females spend in their residential community is significantly more than that of males. In the coastal and central regions females have full-time jobs, like males, and spend the same amount of time in their communities as males. Finally, the total impact of the presence of *children* is significant and negative in the coastal and central region models and insignificant in the inland region model. This variation is due to the fact that mothers in the inland region are less likely have a full-time job, and thus spend more time on caring for their children which compensates for poor living conditions.

4.5 Conclusions and policy implications

This paper analyzes interregional disparities in urban residential satisfaction in the coastal, central and inland regions in China, based on the 2006 wave of the China General Social Survey. It applies structural equation modeling (SEM) to reduce the problem of multicollinearity, and multi-group analysis to reduce the risk that disparities in residential satisfaction are wrongly ascribed to differences in model specification.

The main finding of the paper is that in all three regions *housing quality*, *tenure*, *community type*, *socioeconomic status* and *Hukou* have positive impacts on residential satisfaction and the presence of children a negative effect. The results furthermore indicate that the sizes of the impacts of the determinants of *residential satisfaction* strongly differ across the regions. *Housing quality* is the most important determinant of *residential satisfaction* in the coastal region, *community type* and *Hukou* in the central and inland regions respectively. Meanwhile, *tenure* has a larger total impact in the coastal and inland regions than in the central region which is related to the fact that migrants account for larger parts of the urban population in the former two regions. *Community type* has a

larger impact in the inland region than in the costal and central regions where investments in public goods have improved the shanty, old and resettled housing community such that the difference among communities has been reduced. The impact of *gender* on *residential satisfaction* in the coastal and central regions is insignificant and smaller than in the inland region because female labor market participation is high in the former regions. Consequently, the time females spend in their residential community is not significantly more than that of males. The presence of children has a smaller impact on residential satisfaction in the inland region than in the coastal and central regions because females in the inland region spend more time with their children, which compensates housing and community disamenities.

Another major finding of the paper is that urban residents in the coastal region enjoy smaller housing, less bathrooms and living rooms, even though they have higher education and income than their counterparts in central and inland regions. Urban residents in the coastal region are less likely to be satisfied with their living conditions.

The findings in this paper have some important policy implications. As housing quality has a positive impact on residential satisfaction, social housing policies bring about an increase of residential satisfaction as well as improvement of living conditions, notably for low-income households. Large numbers of low-income households still live in crowded houses. In 2010, 25.50% of urban households' living space was less than 16 square meters while 31.70% of the households had no bathroom (The Sixth National Population Census of China, 2010). China's government should therefore continue implementing its social housing policies. For this purpose, local governments could provide low-cost construction land to housing development companies to develop affordable houses. At the same time, speculation should be prevented. The Chinese government is aware of the problem and has recently introduced the "housing market cooling package" consisting of such measures as higher down payments and higher interest rates, to achieve this goal. Enlargement and strengthening of the cooling package should be considered as housing affordability is low and housing price keeps growing in the coastal and central regions.

Of course, social housing policy as described above implies costs. Therefore, it is important to analyze social housing policy in the context of the costs involved including opportunity costs and taxes. The framework for such analysis is cost-benefit analysis.

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Appendix 4.A

Table 4.A Classification of the provinces

Coastal region		*Central region*		*Inland region*	
Beijing	Zhejiang	Shanxi	Hubei	Inner Mongolia	Shaanxi
Tianjin	Fujian	Jilin	Hunan	Guangxi	Gansu
Hebei	Shandong	Heilongjiang		Chongqing	Xinjiang
Liaoning	Guangdong	Anhui		Sichuan	
Shanghai	Hainan	Jiangxi		Guizhou	
Jiangsu		Henan		Yunnan	